

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
20 December 2001 (20.12.2001)

PCT

(10) International Publication Number
WO 01/96039 A1

(51) International Patent Classification⁷: **B21C 23/08**

(21) International Application Number: PCT/KR01/00842

(22) International Filing Date: 22 May 2001 (22.05.2001)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
2000/32554 10 June 2000 (10.06.2000) KR

(71) Applicant and

(72) Inventor: JIN, Intai [KR/KR]; 1219-128 Nam Ku
Daeyeun2 Dong, Busan 608-022 (KR).

DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR,
HU, ID, IL, IN, IS, JP, KE, KG, KP, KZ, LC, LK, LR, LS,
LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO,
NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR,
TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States (regional): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SI, SZ, TZ, UG, ZW), Eurasian
patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European
patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE,
IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF,
CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

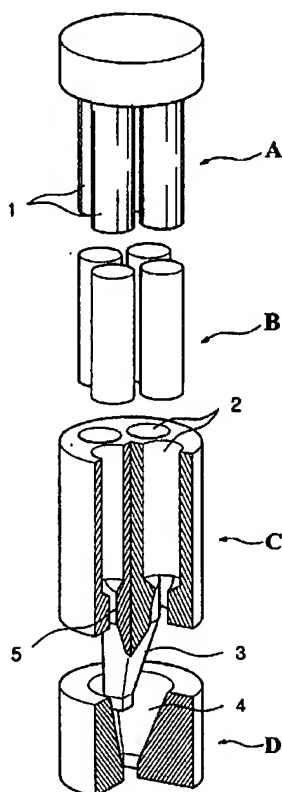
Published:

— with international search report

(81) Designated States (national): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ,

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: A MANUFACTURING DEVICE OF THE CURVED METAL TUBE AND ROD WITH AN ARBITRARY SECTION



(57) Abstract: The purpose of the present invention is to propose a new way of manufacturing curved metal tubes or rods with arbitrary sections and eliminating the conventional bending defects such as thinning and thickening in the wall of tube, distortion of the section, and wrinkling and folding on the surface by the extrusion bending process that can extrude and weld together one or more billets inside dies cavity, and can bend them during extrusion due to the gradient of extrusion velocities controlled by the eccentricity of the cavity sections between the entrance and the exit of the eccentric conical extrusion bending dies and conical plug, or by the relative size of the holes of multi-hole container, or by the relative moving velocity of multi-punches.

WO 01/96039 A1

A manufacturing device of the curved metal tube and rod with an arbitrary section

5 "Technical Field"

This invention relates to the manufacturing devices of curved metal tubes or rods with arbitrary sections. In details, it relates to the devices such that a curved hollow tube or a curved solid rod with various sections like as polygon and longitudinal fins can be extruded
10 and bended very easily with needed curvature by the extrusion bending process.

"Background Arts"

Curved metal tubes or rods have been bended by the second
15 bending process after the first extruding of straight tubes or rods by the extrusion process. However, it is difficult to get precious and standard curved products, because the bending process changes the uniform section of extruded product due to the deformation by bending. Especially, as shown in the lower part of the Figure 8, it is very
20 difficult to bend the extruded products with longitudinal fins inside or outside the wall of tube of irregular sections by the conventional bending process, because it may cause some defects such as thinning and thickening in the wall of tube, distortion of the section, and wrinkling and folding on the surface.

25

"Disclosure of Invention"

The purpose of the present invention is to propose a new way of manufacturing curved metal tubes or rods with arbitrary sections and eliminating the conventional defects in bending by the one extrusion
30 bending process that can extrude and weld together one or more billets inside dies cavity, and can bend them during extrusion due to the gradient of extrusion velocities controlled by the eccentricity of cavity sections between the entrance and the exit of the conical extrusion bending dies, or by the relative size of the holes of the
35 multi-hole container, or by the relative moving velocity of multi-punches.

The present invention for this purposes has the characteristics consisted of two types of device, the one of them is manufacturing device extruding curved metal tubes(100) with arbitrary sections, and

it is composed of the multi-hole container(C) with eccentric conical plug(3) and with multi-holes(2) inserting one or more hot metal billets(B); the extrusion punch(A) with one or more punches(1) to push the billets(B) inserted in the multi-hole container(C); and the eccentric
5 conical extrusion bending dies(D) with an arbitrary cavity(4) section.

The other is manufacturing device of curved metal rods(200) with arbitrary sections, and it is composed of the multi-hole container(C) with multi-holes(2) inserting one or more hot metal billets(B); the extrusion punch(A) with one or more punches(1) to push the billets(B)
10 inserted in the multi-hole container(C); and the eccentric conical extrusion bending dies(D) with an arbitrary cavity(4) section.

This present invention will be described further below with attached drawings.

Figure 1 shows an overall perspective view with partially sectional
15 view of the extrusion bending device for extruding the curved metal tube(100) with rectangular section. And it consists of the extrusion punch(A) with one or more punches(1); one or more hot metal billets(B); the multi-hole container(C) with the eccentric rectangular conical plug(3) and with multi-holes(2) inserting one or more hot metal
20 billets(B); and the eccentric conical extrusion bending dies(D) with the eccentric rectangular conical cavity(4) to be able to insert an eccentric rectangular conical plug(3).

The extrusion punch(A) consists of one or more punches(1) which can be assembled together to push the hot metal billets(B) with same
25 velocity or can be separated individually to push the each billet with each different velocity.

The hot metal billet(B) is an arbitrary metal billet heated to the temperature used generally in the hot extrusion process. The upper part of multi-hole container(C) has one or more holes(2) through
30 which the one or more hot metal billet(B) can pass, and in order to control the bending curvature of curved tubes or rods, the relative diameter of the holes(2) can be adjusted to control the gradient of extrusion velocity at dies exit due to the different amount of billets in each hole,

And the lower part of multi-hole container(C) has one circumferential groove(5) passed through and connected to one or more holes(2), and has the eccentric conical plug(3) surrounded by the ruled surface connecting the inner circular contour of the circumferential groove(5) at the bottom of plug(3) with the rectangular
40 contour of the section at the end of plug(3).

The eccentricity of eccentric conical plug(3) means that the center

of section enclosed by the inner circular contour of the circumferential groove(5) at the bottom of plug(3) does not lie on the same line as the perpendicular line passing through the center of the rectangular section or an arbitrary section at the end of plug(3).

5 And an arbitrary section means that it includes one of the various sections of extruded products, for example, the polygonal section like as rectangular tube and rod, the cylindrical or half cylindrical section, the section with longitudinal fins(6) inside or outside the wall of tube, and H-section, and so on.

10 The extrusion bending dies(D) has the eccentric conical cavity(4) surrounded by the ruled surface connected the contour of a circular cavity section at the conical dies(D) entrance with the contour of a rectangular or an arbitrary cavity section at the conical dies(D) exit.

And the eccentricity of the eccentric conical cavity(4) means that
15 the center of the circular cavity section at the conical dies(D) entrance does not lie on the same line as the perpendicular line passing through the center of the rectangular or an arbitrary cavity section at the conical dies(D) exit.

Figure 6 and 7 show overall sectional view of the extrusion
20 bending device for extruding the curved metal rod(200), and it consists of the extrusion punch(A) with one or more punches(1); one or more hot metal billets(B); the multi-hole container(C) to be able to pass one or more hot metal billets(B) through the multi-holes(2); and the
25 extrusion bending dies(D) with the eccentric conical cavity(4) surrounded by the ruled surface connected the contour of an arbitrary cavity section at the conical dies(D) entrance with the contour of an arbitrary cavity section at the conical dies(D) exit.

And the eccentricity of the eccentric conical cavity(4) section
30 means that the center of an arbitrary cavity section at the conical dies(D) entrance does not lie on the same line as the perpendicular line passing through the center of an arbitrary cavity section at the conical dies(D) exit.

"Brief Description of Drawings"

35 The nature and mode of operation of preferred embodiments of the present invention will now be more fully described in the following detailed description, taken with the accompanying drawings wherein:

Figure 1 is a perspective view with partially sectional view of the
extrusion bending device for extruding the curved rectangular metal
40 tube as a representative example of the present invention;

Figure 2 is a perspective view of a flow of the extrusion material

used in the extrusion bending process of the curved rectangular metal tube with four hot metal billets;

Figure 3 is a cross-sectional view for example of the inserting hot metal billets into the multi-hole container;

5 Figure 4 is a cross-sectional view for example before inserting extrusion punches into the multi-hole container;

Figure 5 is a cross-sectional view for example of the extrusion of the curved metal tube by pushing hot metal billets into the multi-hole container by extrusion punches;

10 Figure 6 is a cross-sectional view before inserting one hot metal billet into the container for the extrusion bending of the curved metal rod as an example of the present invention;

Figure 7 is a cross-sectional view for the extrusion bending of the curved metal rod as an example of the present invention;

15 Figure 8 is a view of examples of the products of curved metal tubes or rods that can be manufactured by the present invention.

<Explanation of the symbol at the indicated point in the drawings>

1: punch	2: hole	3: conical plug	4: cavity
20 5: circumferential groove	6: longitudinal fin		
A: extrusion punch	B: hot metal billet	C: container	
D: extrusion bending dies			
100: curved metal tube	200: curved metal rod		

25 "Best Mode for Carrying Out the Invention"

The device of the present invention is intended to be installed in hot metal extrusion machine so that the present invention can be utilized in the manufacturing of curved metal tubes(100) or rods(200). The exemplary embodiments of a manufacturing process of extruding rectangular curved metal tube are illustrated in the viewing Figure 1-5 with following descriptions of the present invention.

30 For the exemplary embodiment, the device is illustrated in an example that consists of the extrusion punch(A) with four punches(1); four hot metal billets(B); the multi-hole container(C) with four holes(2); and the conical extrusion bending dies(D) with a rectangular cavity(4) section.

40 For more explanation of the detailed manufacturing process, first, the four hot metal billets(B) heated to the degree of hot extrusion temperature are inserted into the multi-hole container(C) with four holes(2), are pushed and moved by four punches(1) loaded with the compressive force, and are extruded to one circular tube welded

together in the circumferential groove(5) passed through and connected to the four holes(2) at the lower part of multi-hole container(C).

5 Next, the one extruded circular tube welded in the circumferential groove(5) is pushed and passed through into the cavity(4) between the inner surface of the eccentric conical extrusion bending dies(D) and the outer surface of the eccentric conical plug(3).

10 And the gradient of the extrusion velocity on the exit cavity section of conical extrusion bending dies(D) due to the eccentricity in the conical plug(3) and in the conical extrusion bending dies(D) should make bending in the extruded product to the opposite direction of the eccentricity of the conical extrusion dies(D), as shown in Figure 5.

15 And the curvature of the extruded product, that is, the amount of bending of rectangular curved tube(100) can be controlled by the eccentricity between the circular cavity section in the circumferential groove(5) at the dies entrance and the rectangular cavity section at the dies exit, or it can be controlled by the changing the relative diameter of the two symmetric holes(2) of the multi-hole container(C), or it can be controlled by the relative moving velocity of two
20 symmetric punches(1) inserted into the four hole(2).

And it is possible to manufacture the curved metal tube(100) whose curvature varies on the length of extruded product due to the gradient of the moving velocities of each billet controlled by the relative moving velocity of two symmetric punches(1) during the
25 extrusion process.

In brief summarization of the extrusion bending process of curved tubes, first, the four hot metal billet(B) are welded together in the circumferential groove(5) and they are extruded to one circular tube, when one circular tube is pushed and passed through into the die
30 cavity(4) between the dies surface and the plug surface, and then the bending should happen due to the gradient of extrusion velocity during the extrusion such that the moving velocity in left side is faster than the velocity in right side as shown in Figure 5. The curvature of the curved product can be controlled by the eccentricity or by the relative
35 diameter of four holes(2) or by the relative velocity of four punches(1).

Although the present example for the embodiment is illustrated in the case of the manufacturing of rectangular curved metal tube(100), however, according to the shape of the end of conical plug(3) connected to the multi-hole container(C) and to the shape of opening
40 of the conical extrusion dies(D), it is possible to manufacture easily the products like as cylindrical and polygonal thin curved tube(100)

with longitudinal fins(6) inside or outside of tube wall as shown in Figure 8, and the curvature of the products can be controlled precisely in a variety of range by the eccentricity or by the relative size of multi-holes(2) or the relative moving velocity of multi-punches(1).

And, as shown in Figure 6-7, in the case of the manufacturing of curved metal rod(200), after that the one or more hot metal billets(B) are inserted into multi-hole container(C) with one or more holes(2) and they are pushed by multi-punches(1), they are welded together in the eccentric conical extrusion bending dies cavity(4) without the conical plug(3) connected to multi-hole container(C), and it is extruded to an arbitrary shaped curved metal rod(200), and when it is extruding in the dies cavity, the bending should happen by the gradient of extrusion velocity during the extrusion such that the moving velocity in left side is faster than the moving velocity in right side as shown in Figure 6-7.

The curvature of the curved metal rod(200) can be controlled by the eccentricity between an arbitrary cavity section at the dies entrance and an arbitrary cavity section at the dies exit or by the relative diameters of multi-holes(2) or by the relative moving velocity of multi-punches(1).

Although the two exemplary embodiments are illustrated as desirable examples of the case of the extrusion bending process with four hot billets(B) and four punches(1) and four-hole container(C), however, the fulfillment with the technically applicable range of the present invention can be made in any other case of the extrusion bending process using with one or more billets(B), with one or more punches(1), and with one or more holes(2).

30 "Industrial Applicability"

The present invention is attributed to the increase of the productivity by combining extrusion process and bending process, so that the cost of production should be decreased by manufacturing curved metal products simultaneously in the one extrusion bending process of the present invention. And it is possible to manufacture the curved tubes and rods without defects such as wrinkling and folding on the surface, and such as distortion in the section, and thickness change of the wall to be occurred easily when the non-symmetric hollow tubes and rods with longitudinal fins(6) should be bended.

"Claims"

1. The manufacturing device for the curved metal tube(100) with an arbitrary section that consists of the extrusion punch(A) with one or more punches(1); one or more hot metal billets(B); the multi-hole container(C) with one or more holes(2) inserting the one or more hot metal billets(B), and it is connected with the eccentric conical plug(3) surrounded by the ruled surface connecting the arbitrary inner contour of the circumferential groove(5) at the bottom of plug(3) with the arbitrary contour of section to be extruded at the end of plug(3); and the eccentric conical extrusion bending dies(D) inserting the eccentric conical plug(3) inside the eccentric conical cavity(4) surrounded by the ruled surface, and it has eccentricity that the center of an arbitrary cavity section at the conical dies(D) entrance does not lie on the same line as the perpendicular line passing through the center of an arbitrary cavity section at the conical dies(D) exit.

2. The manufacturing device for the curved metal rod(200) with an arbitrary section that consists of the extrusion punch(A) with one or more punches(1); one or more hot metal billets(B); the multi-hole container(C) with the one or more holes(2) inserting the one or more hot metal billets(B); and the eccentric conical extrusion bending dies(D) with the eccentric conical cavity(4) surrounded by the ruled surface, and it has eccentricity that the center of an arbitrary cavity section at the conical dies(D) entrance does not lie on the same line as the perpendicular line passing through the center of an arbitrary cavity section at the conical dies(D) exit.

3. As claimed in claim 1 or in claim 2, the manufacturing device for curved metal tubes(100) or rods(200) with an arbitrary section that consists of the extrusion punch(A) with four punches(1); and four hot metal billets(B); and multi-hole container(C) with the four holes(2).

4. As claimed in claim 1 or in claim 2, the manufacturing device for curved metal tubes(100) and rods(200) with an arbitrary section like as cylindrical section or polygonal section and like as cylindrical and polygonal section with longitudinal fins(6) inside or outside the extruded products.

5. As claimed in claim 1 or in claim 2, the manufacturing device for curved metal tubes(100) and rods(200) with an arbitrary section like as H section to be extruded.

6. As claimed in claim 1 or in claim 2, the manufacturing method for curved metal tubes(100) or rods(200) such that the curvature of curved products can be controlled by the eccentricity of the cavity(4) sections between the entrance and the exit of the eccentric conical extrusion bending dies(D) and conical plug(3), or by the relative size of the holes(2) of multi-hole container(C), or by the relative moving velocity of multi-punches(1).

10

15

20

25

30

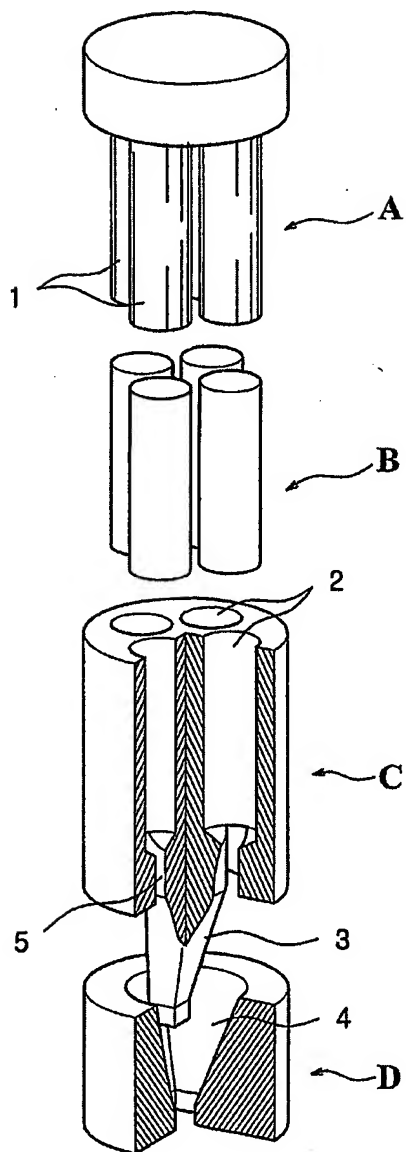
35

40

1/8

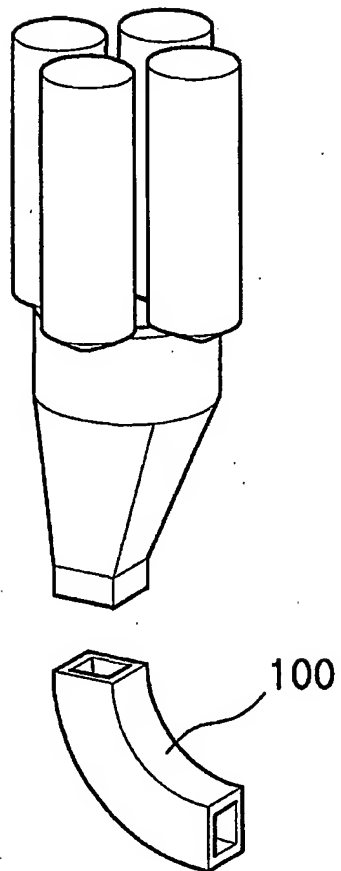
"Drawings"

FIG. 1



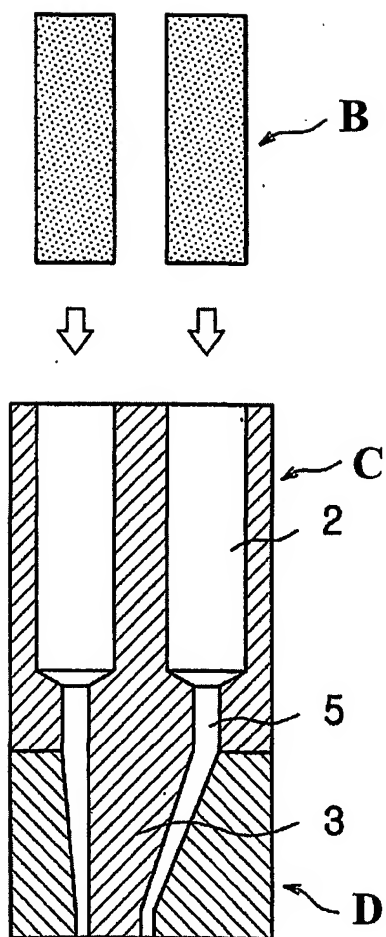
2/8

FIG. 2



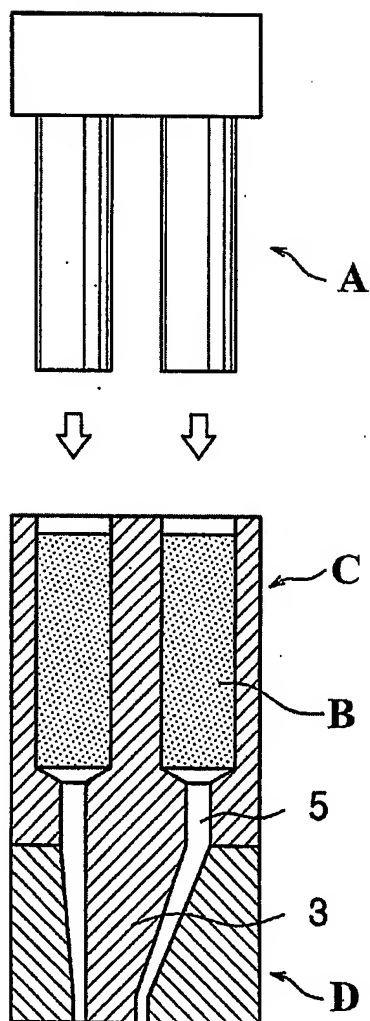
3/8

FIG. 3



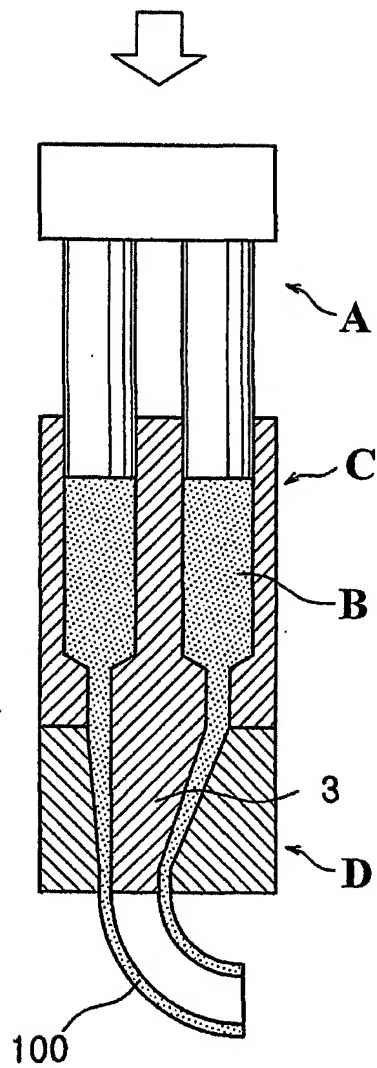
4/8

FIG. 4



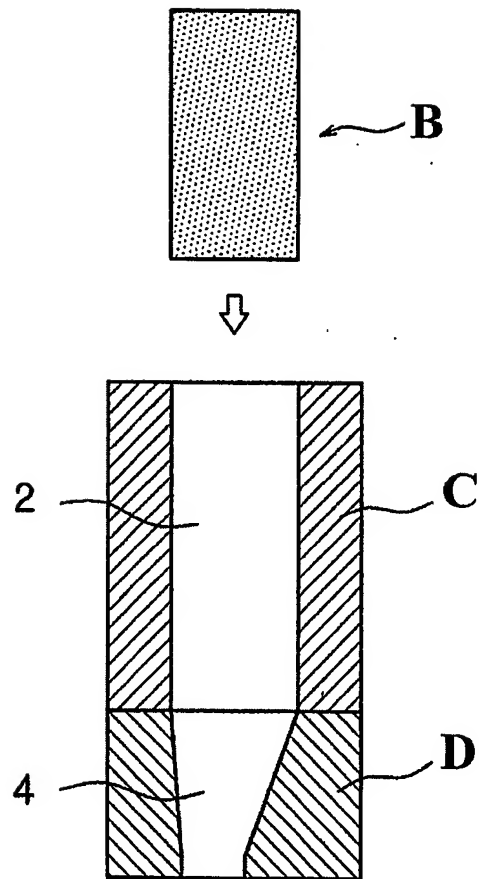
5/8

FIG. 5



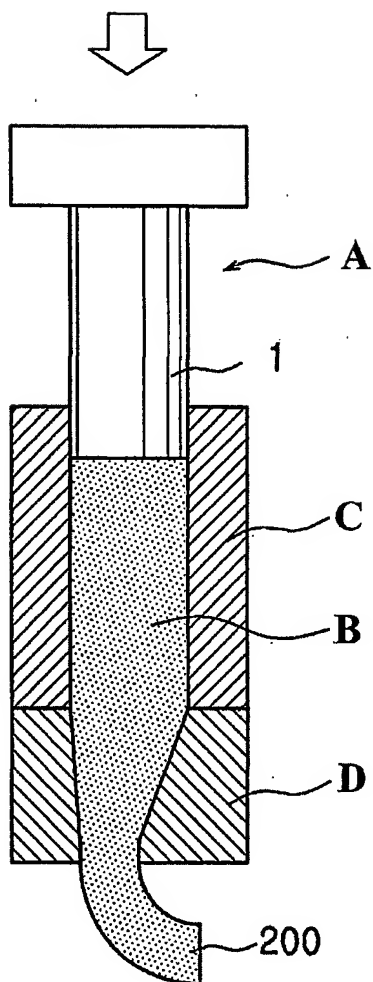
6/8

FIG. 6



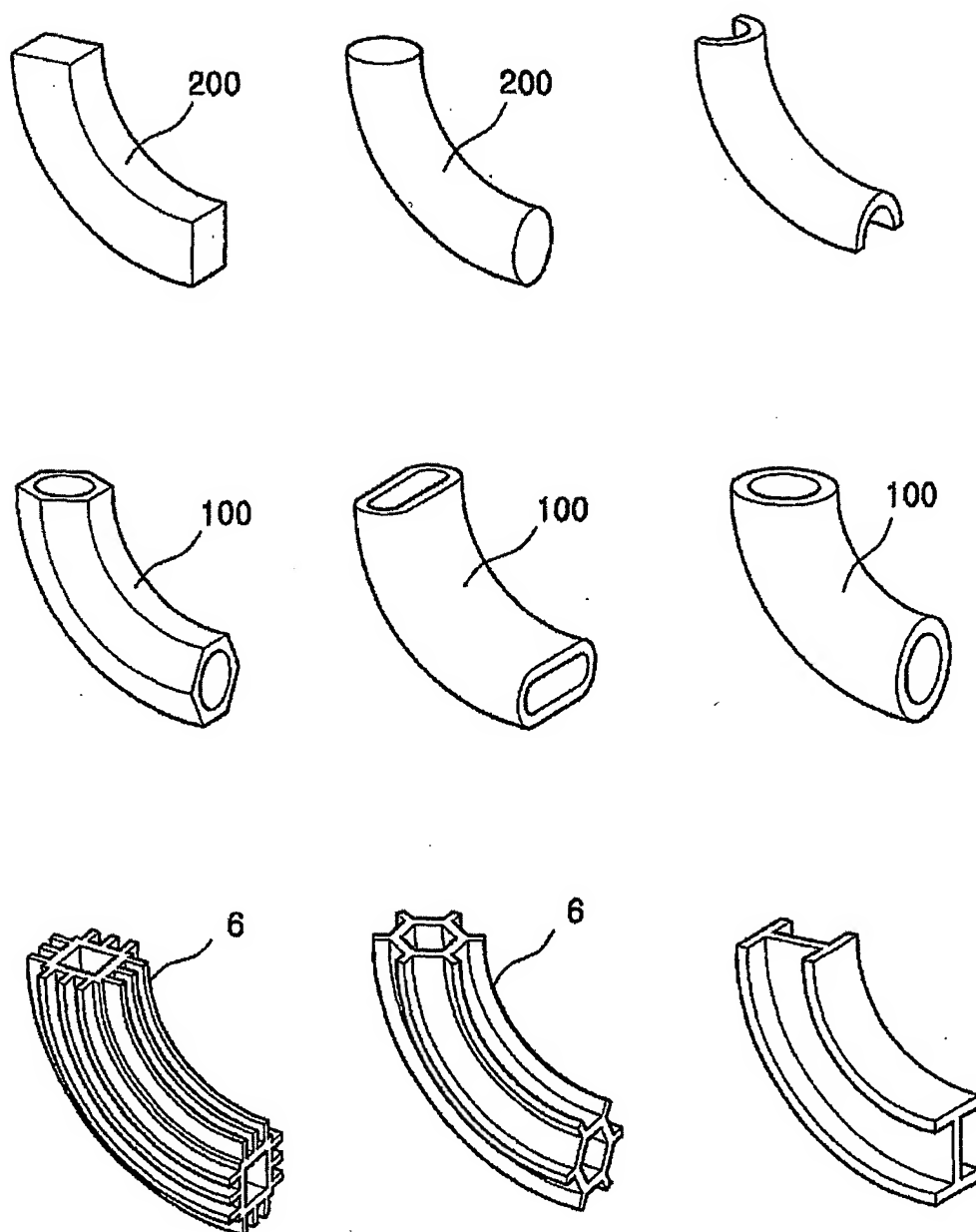
7/8

FIG. 7



8/8

FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR01/00842

A. CLASSIFICATION OF SUBJECT MATTER		
IPC7 B21C 23/08		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) IPC7 B21C 23/08		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Korean Patents and applications since 1975, Korean Utility models and applications for Utility Models since 1975, Japanese Patents and applications since 1975, KR:as above and KR,JP:classes as above		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 7-60340 A (SHOWA ALUMINUM CO. LTD) 7 MARCH 1995	1 - 3
A	JP 2-19287 A (SHOWA ALUMINUM CO. LTD) 30 JULY 1990	1 - 6
A	JP 57-97816 A (KOBEL STEEL CO. LTD) 17 JUNE 1982	1 - 6
A	JP 63-40614 A (SHOWA ALUMINUM CO. LTD) 22 FEB. 1988	1 - 6
A	US 3890822 A (SCAL) 24 JUNE 1975	1 - 6
A	US 4037454 A (WESTERN ELECTRIC COMPANY, INC.,) 26 JULY 1977	1 - 6
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
<p>* Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier application or patent but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>"&" document member of the same patent family</p>		
Date of the actual completion of the international search 11 SEPTEMBER 2001 (11.09.2001)		Date of mailing of the International search report 12 SEPTEMBER 2001 (12.09.2001)
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon, Dunsan-dong, Seo-gu, Daejeon Metropolitan City 302-701, Republic of Korea Facsimile No. 82-42-472-7140		Authorized officer KIM, Su Seong Telephone No. 82-42-481-5525